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Stated Preference Evaluation of Government Budgets

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Abstract

Stated preference approaches are widely used in non-market valuation. However, their potential uses extend far beyond valuation. In particular they can be used to assess efficiency of resource allocations and to design optimal resource allocations. Changes to the government budget were evaluated using a choice experiment. Results indicate potential efficiency gains from reallocation of the budget to items with higher marginal utility. In particular, New Zealand residents want more spending on health, education and the environment, with health spending consistently having the highest marginal benefits. People want less government money spent on income support. The choice experiment was able to identify the impacts of demographic factors. Young people rated spending on the environment and education more highly than other respondents.

Key words: Choice experiment, public preferences, government budget

Introduction

The median voter theorem states that political parties pursue policies that maximize the net benefit of the median voter (Parkin, 1993). Public choice theory espouses the view that in a representative democracy competition among politicians ensures that the public sector bureaucracy responds efficiently to voters' desires (Turnbull & Chang, 1998). Yet public rallies and intense debates in the media suggest that allocations might diverge from public preferences. Investigation of such potential divergences requires adoption of appropriate research methods. The purpose of this paper is to report on an initial application of a method that addresses some of the limitations in existing methods.

Ideally, a budget evaluation method needs to satisfy several evaluative criteria. It should register strength of preference in order to indicate the relative magnitude of benefits from allocating additional budget to specific items, or transferring budget between items. The approach also should be capable of identifying how much money to allocate to individual budget items, how big the total budget should be, and the optimal allocation over all items in the budget. Furthermore, evaluation methods should minimise response biases.

Three broad approaches have been used to study central government budget allocations. Some authors have used an approach that asks survey respondents to indicate whether it is desirable for the government to spend more, the same or less

money (MSL) on particular budget items (Ferris, 1983; Lewis & Jackson, 1985). A similar approach asks survey participants to play a budget game either to design a government budget (de Groot & Pommer, 1989; Kemp, 2003), or to allocate changes in the government budget, within a given set of specified constraints (Blomquist et al., 2000, 2003; de Groot & Pommer, 1989; Israelsson & Kriström, 2001). Psychological approaches have used either magnitude estimation or category rating to evaluate benefits of public spending. Kemp, who pioneered these approaches, prefers category rating (Kemp, 2002). Category rating asks survey participants to score item benefits on a zero to ten scale, with a score of zero indicating no benefits whatsoever. Psychological approaches can be applied to measure total benefits provided by a service, or to measure marginal benefits from small changes in budget allocations (Kemp, 1998, 2003; Kemp & Burt, 2001; Kemp, Lee & Fussell, 1995; Kemp & Willetts, 1995a).

The MSL approach has the advantage of simplicity, both in survey design and for survey participants when constructing their responses. Its main limitations are that it does not convey strength of preference nor does it indicate the amount of change wanted by the public. It can neither identify the optimal size of the government budget, nor the optimal allocation of that budget between competing items.

Budget games yield more information than MSL, but are more difficult for respondents – particularly if they are required to maintain a balanced budget. It is always possible to infer MSL results from unconstrained budget game outcomes. Marginal budget games provide some information on strength of preference, but do not identify the optimal total budget or the best allocation of that budget. Budget games that identify optimal budgets do not provide policy guidance for marginal changes. Consequently, budget games are useful within the specified rules of the game, but may offer little useful information for other proposed changes. For example, a game that allows the total budget to vary and does not place constraints on the magnitudes of changes in particular items may be of little use in evaluating how to disburse (say) a $10 million budget increase in which spending on any single item is not permitted to decrease.

Category rating is not able to identify optimal budget allocations. In evaluating marginal changes, category rating can be used to rank benefits from alternative expenditure categories, but it does not provide cardinal estimates of marginal rates of substitution because of the different ways that individuals use the evaluative scale.

It is possible that spending on some items is viewed negatively, at least by some people. For example, pacifists may view defence spending as undesirable. Even when government provision of a particular service is valued positively in total, it could still be valued negatively at the margin. MSL and unconstrained budget allocation games allow these situations to be signalled. In applications to date, category ratings have been undertaken using a scale that is anchored at the bottom end by zero, with the instruction that a score of zero indicates no value. Registering a negative value is not permitted by this scale.

In reallocating their budgets, governments can choose either to make small changes designed to move towards better outcomes, or to make large scale reallocations designed to deliver an optimal allocation that equates marginal utilities for all items.

Evaluating these two types of changes requires different information. The latter process is best served by budget games that do not restrict allocations to particular categories, but it cannot be informed adequately by MSL or category rating. Small budget changes can be evaluated by any of these approaches, but are best informed by budget games and category rating, which rank marginal benefits.

None of the existing methods meets all evaluative criteria, suggesting the desirability of developing new methods. Choice experiments have been widely applied in the marketing, transport and environmental arenas. They belong to the family of conjoint methods, also known as attribute based methods, that present alternative products or policies that differ on a number of attributes and ask people to reveal their preferences by ranking or scoring alternatives. Choice experiments make the lowest cognitive demands of the conjoint-based approaches because they entail revelation only of the single most preferred alternative.

Choice experiments produce utility functions that allow measurement of marginal rates of substitution. Marginal utilities are not constrained to be positive. Because choice experiment utility functions need not be linear, choice experiments have the potential to inform decisions both at the margin and about optimal budget allocations based on the results of a single study. The purpose of the study reported here was to use a simple choice experiment to investigate whether the outcomes of the political process for central government budget allocation in New Zealand diverge significantly from community values. The choice experiment sought to identify public preferences for the allocation of New Zealand government monies and to address the efficiency of taxing citizens more (or less) to accommodate changed provision of government services.

Choice Experiment Method

Choice modelling can be thought of as mimicking a political process. Participants are given several options (alternatives) from which they must pick a single best alternative. Based on the tenets of random utility theory, the chosen option is assumed to have higher expected utility for the respondent than any other option presented to them. If sufficient information is available on people's choices, it is possible to use statistical methods to derive estimates of coefficients in a utility or preference function that describes how people made those choices (Bennett and Blamey, 2001; Louviere *et al.*, 2000). Once the utility function has been estimated it is a straightforward matter to estimate the rate at which people are willing to trade off attributes.

In March 2002 a self-completed survey seeking perceptions of the state of the New Zealand environment was mailed to 2000 randomly selected people registered on the New Zealand electoral roll (Hughey et al., 2002). After accounting for known non-delivered surveys, a 45% response rate (n=836) was obtained. A choice experiment was included in this omnibus survey. The four items addressed in the choice experiment were *health*, *education*, *income support*, and *conservation & environmental management*. The total budget for these four items could vary, which would directly influence taxes, as could the allocation of the budget between items.

The stated preference question provided survey participants with three options for the allocation of government expenditure between the four budget items. Information was provided on public spending on these items in 2001. The levels of spending on each item defined the options. For any item, spending could be unchanged, could increase by $50 million per year, or could decrease by $50 million per year. There was no requirement to balance the budget, so it was possible to have options that entailed total budget changes across the range ±$200 million. In order to allocate alternatives to treatments, nine trials were identified (following Hahn and Shapiro, 1966) for the case of 4 variables taking 3 levels each. These trials were used as starting points in a shifted-triple design to obtain sets of three alternatives. Each participant faced only one choice question. Survey participants were asked to identify the single option that they preferred, signalling the combination of budget items that yielded the highest expected utility. The status quo was not an option. Figure 1 illustrates a representative choice question.

Figure 1: Choice question

The New Zealand government spends about $36 billion each year on a range of public services.

Suppose the government were thinking about changing the amount it spent on health, education, income support and conservation and environmental management. Any increase in total spending on these items would result in a tax increase, but reduced spending could lower taxes. You are asked for your opinion on the following options. You might think there are better options than these ones, but they are the only options you can choose from for now. Which option do you prefer?

Area of public spending	**Approximate amount spent in 2001 ($ million)**	**Change in spending each year ($ million)**		
		Option 1	**Option 2**	**Option 3**
Health	$7,000 m.	$50 m. less	no change	$50 m. more
Education	$6,733 m.	$50 m. less	$50 m. more	no change
Income support	$13,000 m.	$50 m. less	$50 m. more	no change
Conservation and environmental management	$500 m.	$50 m. less	no change	$50 m. more
Change in total taxes collected		$200 m less	$100 m more	$100 m more

☐ I like option 1 best

☐ I like option 2 best

☐ I like option 3 best

Diminishing marginal utilities imply that utility functions are not linear. Indeed, internal solutions to the budget allocation exercise require a non-linear utility function. However, over small changes in the levels of budget items it is possible to approximate the utility function using a linear form. The range over which the

proposed budget changes deviate from the current budget allocations is small (10% for conservation and less than 1% for the other items), indicating the appropriateness of linear approximations to the utility function.

The underlying linear utility function is:

$$U = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 TAX = \boldsymbol{\beta} X \quad \textbf{(1)}$$

Where $TAX = X_1 + X_2 + X_3 + X_4$

TAX is the total cost of spending on the four items included in the choice experiment. Items other than those addressed in equation **(1)** also influence utility, but since expenditures on other budget items and their influence on taxes do not vary, they are suppressed in **(1)**.

The vector $\boldsymbol{\beta}$ identifies marginal utilities. Because tax is a linear function of the other parameters, it is redundant in the utility function **(2)**.

$$U = (\beta_1+\beta_5)X_1 + (\beta_2+\beta_5)X_2 + (\beta_3+\beta_5)X_3 + (\beta_4+\beta_5)X_4 \quad \textbf{(2)}$$

Consequently, it is not possible to identify (1), or to retrieve $\boldsymbol{\beta}$. Because parameter estimates from the multinomial logit model are unique only up to a scale factor, fixing the marginal utility of money at unity (i.e. $\beta_5 = -1$) does not solve this identification problem. However, it is possible to identify **(3)**.

$$U = \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 = \boldsymbol{\alpha} X \quad \textbf{(3)}$$

Where $\alpha_i = \beta_i + \beta_5$

Each α_i is **net** marginal utility of spending on item i, which includes the benefits obtained from spending on the item, as well as the disutility of paying higher taxes required to fund that additional spending. This is the model fitted to the data.

Results

Results for linear utility functions estimated with the multinomial logit model are reported in Table 1. Model A is the simplest model, incorporating only the direct effects of the individual budget items. The remaining models relax this restriction, incorporating individual-specific attributes in the utility function.

These models have moderate predictive ability, and the core independent variables are highly significant. The coefficients on income support in Models A and B are negative and highly significant, indicating that people prefer reduced spending on income support. Coefficients on the other three budget items are all significantly positive, indicating a desire for increased spending on those items.

Table 1: Estimated models

	Model A	Model B	Model C	Model D
Health	1.088 E-2***	1.104 E-2***	1.159 E-2***	1.163 E-2***
Education	8.259 E-3***	8.348 E-3***	2.200 E-2***	2.222 E-2***
Support	-6.996 E-3***	-7.385 E-3***	-2.472 E-2***	-2.460 E-2***
Environment	6.859 E-2***	1.290 E-2***	1.749 E-2***	2.137 E-2***
Age*Education			-2.585 E-4***	-2.635 E-4***
Age*Support			3.361 E-4***	3.353 E-4***
Age*Environment		-2.005 E-4***	-2.734 E-4***	-2.782 E-4***
NZ Born*Environment		5.237 E-3**	4.801 E-3*	
McFadden's R^2	0.096	0.110	0.134	0.130

Marginal utility from health spending appears to be relatively uniform across all ages, whereas the relative benefits from spending on income support increase with age and benefits from spending on education and the environment decline with age, and at similar rates. New Zealand born respondents perceive greater value from environmental spending than do others, although this effect is of marginal significance.

Economic modelling

The ultimate benefit of developing models of utility dependent on government spending is that alternative policies may be evaluated. This section considers two policy options for funding additional expenditure on any budget item are:

1) Raise taxes to pay for additional spending on item i, leaving other spending unaffected.
2) Hold total taxes constant and pay for increased spending on item i by reducing spending on item j (or on several items) by an equivalent amount.

Raise taxes to pay for extra spending on item i (*ceteris paribus*)

Whenever marginal utility net of tax ($\alpha_i = \beta_i + \beta_5$) is positive taxes should be increased to allow additional spending on item i. However, because the βs are independent of expenditure levels, the linear utility function approximation cannot be used to identify how much additional tax should be raised to provide for increased spending on any item.

Balanced Budget

When spending on one item (X_j) is reduced to allow increased spending on another (X_i) with a balanced budget ($dX_j = -dX_i$), the change in utility is [From **(1)**]:

$$dU = \beta_i dX_i + \beta_j dX_j$$

$$\frac{dU}{dX_i} = \beta_i - \beta_j$$

In this case utility is maximized when spending is reallocated from the item with the smallest β to the item(s) with the largest β. The same result is obtained when **(3)** is estimated.

$$dU = (\beta_i + \beta_5)dX_i + (\beta_j + \beta_5)dX_j$$

$$\frac{dU}{dX_i} = (\beta_i + \beta_5) - (\beta_j + \beta_5) = (\beta_i - \beta_j)$$

All spending should be transferred to the item with the largest marginal utility net of tax (α_i). Inability to estimate **(1)** is not problematic for Policy 2.

Table 2 provides estimates of differences in marginal utilities, along with significance tests derived using 10,000 replications in a Monte Carlo procedure described by Krinsky and Robb (1986).

Table 2: Marginal utility differences

Age	Health - Environment	Health - Education	Education - Environment	Environment - Support	Health - Support	Education - Support
			Model A			
n.a.	0.0040***	0.0026**	0.0014	0.014***	0.018***	0.015***
			Model D			
20	-0.0042*	-0.0053**	0.0011	0.034***	0.030***	0.035***
30	-0.0014	-0.0027	0.0013	0.028***	0.026***	0.029***
40	0.0014	0.0000	0.0014	0.021***	0.023***	0.023***
50	0.0041***	0.0026*	0.0016	0.015***	0.019***	0.017***
60	0.0070***	0.0052***	0.0017	0.0092***	0.016***	0.011***
70	0.0097***	0.0079***	0.0019	0.0030	0.013***	0.0049**

Significance levels: * (10%), ** (5%), *** (1%)

The coefficient differences (β_i - β_j) allow the items to be ranked. A positive difference indicates that spending on item i provides more utility at the margin than spending on item j. Welfare would be improved by transferring spending from item j to item i in such cases. Three coefficient differences in Model D are not significantly different from zero at the 95% confidence level, meaning that Model D is unable to rank reliably health, education and environment for a 50 year old, although it does indicate that marginal spending on any of these items provides more utility than spending on income support.

For Model A it is possible to conclude that health spending provides more benefits than do either environment or education spending. The following hierarchy applies with better than 95% confidence:

$$\text{Net MU}_{\text{Health}} > \{\text{Net MU}_{\text{Education}}, \text{Net MU}_{\text{Environment}}\} > 0 > \text{Net MU}_{\text{Income Support}}$$

While the marginal utility difference between education and the environment is not significantly different from zero, the models consistently rank $MU_{Education} > MU_{Environment}$.

The predictions from Model D vary significantly with respondent age (Table 2). Marginal utilities for health, education and the environment are larger than for income support for all age groups, except for 70 year olds who no longer have a clear

preference for environmental spending over income support. There are no significant differences in marginal utility for spending on the environment and on education for any age group. However, younger respondents were more likely to value environmental and educational spending more highly than health spending. This outcome is consistent with Kemp & Burt (2001).

Model B provides the opportunity to identify differences between people born in New Zealand and others (Table 3). Within these groups, relative willingness to spend on health and education in preference to the environment increases with age. This result is consistent with earlier models. New Zealand born respondents place a higher relative value on the environment than do those who were born overseas, with overseas born 70 year olds obtaining negative net benefits from additional environmental spending.

Table 3: Model B expected marginal utility differences

Age	Born	Health - Environment	Education - Environment	Environment - Support
30	NZ	-0.00108	-0.00377*	0.0195***
	Not NZ	0.00416	0.00147	0.0143***
50	NZ	0.00293**	0.000238	0.0155***
	Not NZ	0.00817***	0.00548**	0.0103***
70	NZ	0.00694***	0.00425**	0.0115***
	Not NZ	0.0122***	0.00948***	0.00625**

Significance levels * (10%), ** (5%), *** (1%)
Health –Support 0.0184***, Health – Education 0.00269**, Education – Support 0.0157***

Discussion

An initial convergent validity test of choice experiment results is provided by comparison with Kemp's findings. The highest marginal value ratings in New Zealand category rating studies are achieved by health, education and police (Kemp & Willetts, 1995a; Kemp, 1998, 2003; Kemp & Burt, 2001). These category rating studies rank the environment in the middle range, whereas spending on income support is always rated lowly. While the present study addresses a much narrower range of government services than the category rating studies, it indicates similar perceptions about the value of government services. Choice experiment results indicate preferences for reduced spending on income support, with the community signalling a strong desire to spend more on health, and being willing to support additional spending on education and the environment. Education and environment spending provide lower marginal benefits than health spending. The choice experiment and category rating studies are consistent in indicating a strong community preference for spending on health, education and the environment rather than on social security.

A further test of convergent validity is provided by a budget game undertaken concurrently with the choice experiment (Hughey et al., 2002). Survey participants were informed of current government spending on six items and asked to identify their preferred budget allocation over those items, given that total expenditure could not change from the initial total of $30 billion per year. The budget items were slightly different to those in the choice experiment. Whereas the choice experiment

addressed *Income Support*, the budget game contained a composite item *Superannuation and Income Support*, and referred to *Conservation and the Environment* rather than *Conservation and Environmental Management* that was addressed in the choice experiment. The budget game included the items defence and crime prevention which did not appear in the choice experiment. Balanced budget responses to the budget game question were provided by 564 respondents (67.5%). Table 4 summarises responses.

Table 4: Preferred budget allocation changes

Item	2001 spending ($b)	Preferred CHANGE in spending					
		Minimum ($b)	Maximum ($b)	Median ($b)	Mean ($b)	SE	Mean/ SE
Defence	1	-1.0	14.0	0	0.141	0.049	2.88
Education	7	-7.0	6.0	0	0.457	0.063	7.25
Crime Prevention	1.5	-1.5	13.5	0	0.378	0.052	7.27
Health	7	-7.0	13.0	0.5	0.892	0.076	11.74
Superannuation & Income Support	13	-13.0	2.0	-2.5	-2.903	0.135	-21.50
Conservation & Environment	0.5	-0.5	29.5	0.5	1.035	0.098	10.56
Total	**30**				**0.0000**		

Preferred levels of spending in the budget game were all significantly different from actual expenditures at the time of the survey. Respondents wanted a substantial decrease in spending on superannuation and income support (95% confidence interval: $2.6 billion ~ $3.2 billion decrease). Increased spending was desired in all other categories, with the largest desired increase in spending being on conservation and the environment (95% confidence interval: $0.84 billion ~ $1.23 billion increase). Budget game participants also preferred a substantial increase in health spending.

The choice model identifies marginal net benefits, whereas the budget game identifies the optimal budget allocation. Consequently, the magnitudes of preferred budget changes in the budget game cannot be directly compared with marginal benefit ranks from the choice model. However, the direction of preferred changes from the two approaches is consistent, with both signalling preferences for increased spending on health, education and the environment, and reduced spending on income support.

Choice experiments have the potential to identify optimal budget allocations when non-linear utility functions are utilised. Results then could be compared directly with budget game outcomes. In this case, a second-order polynomial utility function was estimated, but showed no improvement over the simple linear model. This outcome may have arisen because of the relatively small changes in individual budget items in the choice sets.

Initial tests of a logarithmic utility function show some promise (Kerr et al., 2003). Because of high correlations, the logarithmic model does not resolve the

identification problem inherent in the linear and polynomial models for the case study. However, logarithmic utility function results mirrored those of the linear model - indicating efficiency benefits from transferring budget from income support to health, education and environment, with the bulk of reallocated funds going to health spending. The logarithmic utility function model has the ability to account for costs of service provision and illustrates that the community is willing to increase taxes to increase spending on health, education, and the environment.

The collinearity problem may be surmountable by including additional spending items in the choice sets or increasing the number of attributes in the experimental design. In particular, the income support item used in the choice experiment may be too poorly defined because it incorporates a large number of sub-categories which may be judged quite differently. Disaggregation of income support may remove the high correlation between taxes and income support that precluded inclusion of both variables in the models. An alternative solution may rest in utilisation of alternative functional forms, which deserve further research investigation.

Conclusions

The choice experiment approach to identification of efficient budget allocation is novel. This application has been successful in that marginal utility differences between individual budget categories have been estimated within relatively narrow confidence intervals. The model has been less successful at measuring the marginal utility of spending on particular items. However, in theory, this can be done using non-linear utility functions.

Choice experiment results pass initial convergent validity checks. The results obtained in the choice experiment, the budget game and the extensive evidence presented by Kemp and associates are in agreement. This weight of evidence suggests that the community would prefer less government spending on income support and increased spending on health, education and the environment.

The potential to use choice experiments to identify marginal benefits as well as optimal budget allocations gives the choice experiment approach a theoretical advantage over category rating and budget games. Choice experiments have the ability to apply mathematical models of preference, which provides opportunities to statistically test the importance of demographic factors on preferences. Age and country of birth were shown to be significant in the case study. Choice experiments may have benefits in reducing response biases, although these have not been investigated in the current study.

This initial trial of the choice approach to modelling community preferences, along with the potential advantages the approach offers, indicates the method has strong potential and suggests that further research into design improvements, advantages and limitations is warranted.

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